

APPENDIX C • NOTATION

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ROMAN SYMBOLS, ACRONYMS & CONTRACTIONS

A

A advection of TKE
albedo
ampere (a unit of electrical current)
amplitude
area
Ball ratio = 0.2
initial analysis
north-south amplitude of a wave
parameter or constant (varies by context)
AAM absolute angular momentum
AB Alberta, Canada postal code
ABL Atmospheric Boundary Layer
ACARS aircraft communication and reporting system
A_D albedo of dark-colored daisies
A_G albedo of bare ground
AGL above ground level
AIREP aviation report
AK Alaska, USA postal code
AL Alabama, USA postal code
A_L albedo of light-colored daisies
AMDAR aircraft meteorological data relay
AO Arctic Oscillation
AR Arkansas, USA postal code
Ar argon
ARPEGE Action de Recherche Petite Echelle Grande Echelle (weather-forecast model)
ASDAR aircraft to satellite data relay
ASOS automatic surface observing system
AT apparent temperature (heat index)



“Practical Meteorology:
An Algebra-based Survey
of Atmospheric Science”

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AVCS arbitrary vertical cross-section
A_w global albedo corresponding to an atmospheric window
AWOS automatic weather observing system
AZ Arizona, USA postal code
a acceleration
attenuation coefficient
length of semi-major axis of earth's orbit = 149.457 Gm
parameter or constant (varies by context)
spillage distance of front (= external Rossby radius of deformation)
surface albedo
ā vector acceleration
ā mixed-layer transport coefficient = 0.0063
a_H inverse of cosine function (cos⁻¹)
arccos inverse of sine function (sin⁻¹)
arcsin inverse of tangent function (tan⁻¹)
arctan inverse of sine function (sin⁻¹)
asin atmospheres (a pressure unit)
atm absorptivity
a_λ

B

B Beaufort wind scale
bias score
bowen ratio
breakdown potential for dry air = 3x10⁹ V km⁻¹
buoyant production or consumption of TKE
BC boundary conditions
British Columbia, Canada postal code
BLG boundary-layer gradient (wind)
BRN bulk richardson number
BSS Brier Skill Score
B_λ black-body radiation of a certain wavelength
parameter or constant (varies by context)
b absorption cross section
damping factor
extinction cross section
length of semi-minor axis = 149.090 Gm
parameter or constant (varies by context)
parameter or constant (varies by context)
b₁ dimensionless coefficient
b_D dimensionless coefficient
b_H convective transport coefficient

C

C angular rotation in a full circle (360° or 2π radians)
circle circumference (360° or 2π radians)
circulation
climatological condition
cost
dimensionless concentration
fractional area covered
parameter or constant (varies by context)
specific heat capacity
CA air discharge
California, USA postal code
C_a absolute circulation
CAN Canada
CAPE Convective Available Potential Energy
CAPPI constant altitude plan position indicator
CAT clear-air turbulence

C_B Bernoulli's constant
CC cell circulation
cloud-to-cloud
charge-coupled devices
CCL convective condensation level
CCN cloud condensation nuclei
C_D drag coefficient
fraction of the globe covered by dark daisies
CF coriolis force
CFL Courant-Friedrichs-Lewy (condition for numerical stability)
CG cloud-to-ground
C_G fractional area covered by bare ground
C_H bulk heat-transfer coefficient
CH₄ methane
CI capping inversion
CIN convective inhibition
CL classic
C_L fraction of the globe covered by light daisies
CMC Canadian Meteorological Center
CO carbon monoxide
Colorado, USA postal code
CO₂ carbon dioxide
CP cumulative probability
C_p specific heat of air at constant pressure
C_{pd} specific heat of dry air at constant pressure = 1004.67 J·kg⁻²·K⁻¹
C_{pv} specific heat for water vapor at constant pressure = 1875 J·kg⁻¹·K⁻¹
C_r relative circulation
CRT video screen. Literally: Cathode Ray Tube
C_s seed coverage
CSI critical success index
CT Connecticut, USA postal code
Cu cumulus cloud
Curv curvature
C_v specific heat at constant volume
C_{vd air} specific heat of dry air at constant volume
C_w vertical drag coefficient
C_y dimensionless cross-wind integrated concentration
°C degrees Celsius or centigrade, a unit of temperature
c concentration of a pollutant
density correction factor
half the distance between two foci of an ellipse
maximum concentration
parameter or constant (varies by context)
phase speed or shallow-water wave speeds
speed of light through air at sea level pressure = 299,710,000 m·s⁻¹
speed of sound
c₀ speed of light in a vacuum = 299,792,258 m·s⁻¹
c₁ parameter or constant (varies by context)
c₂ parameter or constant (varies by context)
c₃ parameter or constant (varies by context)
c₄ parameter or constant (varies by context)
cd “candela, a unit of luminous intensity”
c_g group speed or group velocity
c_i speed of light through medium i
cm centimeter, a length unit
cos cosine
covar covariance
cP continental polar air mass
c_y crosswind-integrated concentration

α_{β} intermediate calculation parameter for atmospheric optical ray paths

D

D daylight duration hours
 death rate of daisies
 diffusivity = $2.11 \times 10^{-5} \text{ m}^2 \text{ s}^{-1}$ for water vapor in air under standard conditions
 distance
 drop diameter
 duration of positive heat flux
 fractal dimension
 modern description
 parameter or constant (varies by context)

precipitation duration (h)
 size of particle
 width of flow
 DA data assimilation
 DC District of Columbia, USA postal code
 DE Delaware, USA postal code
 DIAL differential absorption lidars
 DJF "December, January, and February"
 DMSF defense meteorological satellite program
 DT Daylight Savings Time
 DW diabatic warming rate
 D_φ differential heating
 D_φ net radiative flux, or differential heating,

d days, a time unit
 depth
 diagonal length
 distance between crest and trough of a wave
 distance between earth and sun = 149.6 Gm
 Julian day
 plume spread
 thickness
 d_{max,rain} total accumulated depth in a rain gauge
 d_r Julian day of summer solstice = 173
 d_w precipitable water
 d_v number of days in a year
 dBZ decibels of Z - units of radar reflectivity
 Δd phase shift

E

E collision efficiency
 East
 efficiency
 electric field
 energy
 incoming or outgoing radiative flux
 irradiance
 turbine efficiency
 E₀ theoretical efficiency
 E₁ parameter or constant (varies by context)
 E_c collection efficiency
 ECMWF European Centre for Medium-Range Weather Forecasts
 EHI Energy helicity index
 E_{in} incoming flux
 zonally and annually averaged incoming radiative flux
 E_{insol} annual average insolation
 EL equilibrium level
 E_{max} maximum efficiency
 E_{net} differential heating due to radiation
 net radiative flux
 zonally and annually averaged net radiative flux
 EOF Empirical Orthogonal Function
 E_{out} outgoing flux
 zonally and annually averaged outgoing flux
 EPA U.S. Environmental Protection Agency
 EQ equator
 ETS equitable threat score
 EU European Union
 Evap evaporation rate
 EZ entrainment zone

E_φ incoming or outgoing radiative flux at latitude φ
 \bar{E} average daily insolation
 E' coalescence efficiency
 E* total irradiance
 E*_λ emittance/radiant existence/irradiance
 irradiance at wavelength λ
 e base of natural logarithms = 2.7182818285
 current or voltage
 eccentricity
 eccentricity of earth's orbit = 0.0167
 vapor pressure
 e₀ saturation vapor pressure = 0.611 kPa at 0 °C
 e_{IR} IR surface emissivity
 e_s saturation vapor pressure over flat pure water
 saturation vapor pressure
 e_s* actual saturation vapor pressure
 e_w equilibrium emissivity corresponding to an atmospheric window
 exp base of natural logarithms = 2.7182818285
 e_λ emissivity at wavelength λ

F

F flux density
 kinematic flux
 false-alarm rate
 force
 forecast
 Fujita tornado damage scale
 vector force
 free atmosphere
 FAR false-alarm ratio
 FAS Federation of American Scientists
 tracer flux
 F_{CF} Coriolis force
 F_{CN} centrifugal force
 F_E latent heat flux from earth's surface up into the air (in kinematic units of Km-s⁻¹)
 FFD Forward flank downdraft
 FG flux gradient
 F_G molecular heat conduction
 heat flux conducted from the ground up to the earth's surface (in kinematic units of Km-s⁻¹)
 F_H sensible heat flux from earth's surface up into the air (in kinematic units of Km-s⁻¹)
 F_{Hsfc} surface kinematic heat flux
 FL Florida, USA postal code
 F_{net} net vector force
 FNMOC Fleet Numerical Meteorological and Oceanographic Center
 F_{PG} Pressure gradient force
 F_{PGm} mesoscale pressure-gradient force
 F_{PGs} synoptic pressure-gradient force
 Fr Froude number
 F_{rad} radiative flux at a surface
 FS Frontal strength
 F_{TD} turbulent drag force
 FV3 Finite Volume - version 3
 F_x kinematic heat flux component in x direction
 component of net vector force toward the east
 F_y kinematic heat flux component in y direction
 meridional heat transport
 F_z kinematic heat flux component in z direction
 F* net radiative flux at earth's surface (in kinematic units of Km-s⁻¹)
 °F Fahrenheit, a unit of temperature
 \mathbb{F} flux (dynamic)
 \mathbb{F}^* net radiative flux at earth's surface (in dynamic units of W-m⁻²)
 \mathbb{F}_{diff} diffusive moisture flux
 \mathbb{F}_E latent heat flux from earth's surface up into the air (in dynamic units W-m⁻²)
 \mathbb{F}_G heat flux conducted from the ground up to the earth's surface (in dynamic units

of W-m⁻²)
 \mathbb{F}_H sensible heat flux from earth's surface up into the air (in dynamic units W-m⁻²)
 \mathbb{F}_{rad}^* net radiative flux
 \mathbb{F}_x dynamic heat flux in x direction
 \mathbb{F}_y dynamic heat flux in y direction
 \mathbb{F}_z dynamic heat flux in z direction
 f oscillation frequency
 feedback factor
 f_c Coriolis parameter
 centrifugal force
 f_G pull (force) by earth's gravity
 f₀ reference Coriolis parameter at the center of the beta plane
 ft feet, a length unit
 ft H2O feet of water, a pressure unit
 f_x fraction of cloud sizes
 F_{z eff sfc} effective surface heat flux

G

G cyclone graveyard
 gain
 geostrophic wind speed
 gravitational constant = $6.67 \times 10^{-11} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1}$
 intermediate circulation parameter
 theoretical geostrophic value
 GA Georgia, USA postal code
 GB gigabyte
 GCM global climate model
 GCM general circulation model
 GEM Global Environmental Multiscale (Canadian numerical model)
 GFS Global Forecast System
 GHG greenhouse gas
 Gm gigameter, a length unit
 G_m gap-geostrophic wind
 GMT Greenwich Mean Time
 GPS global positioning system (via satellite)
 GPU Graphics Processing Unit
 GSM global spectral model
 GSS Gilbert's skill score
 GTS global telecommunication system
 g grams, a unit of mass
 gravitational acceleration = -9.8 m-s^{-2} (negative means downward)
 g' reduced gravity

H

H geopotential height
 high pressure center
 high
 hit rate
 heating rate
 helicity
 unperturbed ocean depth
 H₂ hydrogen
 H₂O water
 H₂O₂ hydrogen peroxide
 H₂SO₄ sulfuric acid
 HC hurricane category
 He helium
 H_e e-folding depth
 HI heat index apparent temperature
 Hawaii, USA postal code
 HNO₃ nitric acid
 H₀ scale height for pressure
 HP High precipitation
 H_{RR} rate of energy release over unit area of earth's surface
 HSS Heidke skill score
 Hz "hertz, a unit of frequency"
 H_ρ scale height for density
 h depth
 depth of cold air
 depth of stable boundary layer
 enthalpy
 height
 hours, a unit of time
 wave height
 h₀ hour angle

h_2	parameter or constant (varies by context)	KS	Kansas, USA postal code		second
h_{gust}	gust front depth	kt	knot (unit of speed = 1 nautical mile per hour)	MJO	Madden-Julian Oscillation
h_w	depth of air containing waves	KY	Kentucky, USA postal code	MKS	metric system (SI) of units. Literally: M= meters, K= kilograms, S = seconds
I		L		ML	mixed layer
[I]	identity matrix	L	horizontal distribution of temperature	M_{max}	maximum tangential wind
I	precipitation intensity		latent heat factor	MN	Minnesota, USA postal code
I*	net longwave radiation		length	MO	Missouri, USA postal code
\uparrow	upwelling longwave		low pressure perturbation	MOS	Model Output Statistics
\downarrow	downwelling longwave		low-pressure center	M_{out}	exit speed of wind
I_0	intensity of incident radiation		Obukhov length	M_r	radial velocity
	parameter or constant (varies by context)		radiation out		total gradient wind speed
I_1	parameter or constant (varies by context)	L_a	solar luminosity	M_{rad}	radial (inflow component of velocity
IA	Iowa, USA postal code	L_A	attenuation factor	MRF	medium-range forecast
Ic	cubic ice	LA	Louisiana, USA postal code	M_s	molecular weight of solute
IC	initial conditions	LCL	lifting condensation level	MS	Mississippi, USA postal code
ICSI	International Classification for Seasonal Snow on the Ground	L_d	latent heat of deposition or sublimation = (+/-) $2.83 \times 10^6 \text{ J}\cdot\text{kg}^{-1}$	MSE	mean squared error
ID	internal dynamics	LDR	linear depolarization ratio	MSESS	mean squared error skill store
Idaho	Idaho, USA postal code	L_f	latent heat of fusion or melting = (+/-) $3.34 \times 10^5 \text{ J}\cdot\text{kg}^{-1}$	MSL	mean sea level
IDF	intensity-duration-frequency	LFC	level of free convection	MT	Montana, USA postal code
IFS	Integrated Forecast System	LFM	limited-area fine-mesh	M_t	translation speed
Ih	hexagonal ice	LFS	level of free sink	M_{tan}	tangential component of velocity
IL	Illinois, USA postal code	LFS	level of free sink	M_{TH}	magnitude of thermal wind
IN	Indiana, USA postal code	LHS	left hand side	MUR	maximum unambiguous range
IPCC	Intergovernmental Panel on Climate Change	LOC	limit of convection	MW	mega Watts
IPV	isentropic potential vorticity	LP	low precipitation	m	mass
IR	infrared	L_v	latent heat of vaporization		dimensionless diffraction parameter
I_{scat}	intensity of scattered radiation		latent heat of condensation or vaporization = (+/-) $2.5 \times 10^6 \text{ J}\cdot\text{kg}^{-1}$	m_{H_2O}	mass of water, a pressure unit
ITCZ	intertropical convergence zone	LWC	liquid-water content	m_{air}	mass of air
i	grid index	L_x	location parameter	mb	millibars, a pressure unit
	index	L_e	dissipation length scale	$m_{condensing}$	mass of water vapor that condensed
	number of ions per molecule	L_λ	radiance that exists the atmosphere at a certain wavelength	mm Hg	millimeters of mercury, a pressure unit
	time index	l	liter, a unit of volume	min	minutes, a unit of time
	van't Hoff factor	l_b	buoyancy length scale	mole	amount of substance
in	inch, a unit of length	lb	"pound, a unit of mass. Also used as a unit of weight (pounds-force), which is the force experienced by a pound-mass under the influence of gravity"	mph	miles per hour
in Hg	"inches of mercury, a pressure unit"	liter	a unit of volume	m_{planet}	mass of a planet
J		l_m	momentum length scale	m_e	mass of solute
J	cost function	ln	natural logarithm (base e)	mT	maritime Tropical air mass
Joule	Joule, a unit of energy	log	common logarithm (base 10)	m_w	mass of a water molecule
JJA	June, July, and August			m_w	molecular weight
JNWPU	Joint Numerical Weather Prediction Unit			m_{water}	mass of water
j	grid index	M		N	
K		M	actual wind	N	energy
K	eddy diffusivity		mass of earth		Newtons, a unit of force
	eddy viscosity		mean anomaly		north
	Kelvins, a unit of absolute temperature		number of tiles per side		number of data points
	refractive-index magnitude		vertical distribution of temperature		number of drops greater than a given radius
	total number of height levels or layers	M_0	wind speed		number of tiles through which the perimeter passes
K_{DP}	specific differential phase		location parameter	N_0	refractivity
K_E	eddy diffusivity for moisture	M_1	wind speed in residual layer	N_1	parameter or constant (varies by context)
KE	kinetic energy	M_2	walking speed = $2 \text{ m}\cdot\text{s}^{-1}$	N_2	abundance parameter
KF	Kalman Filter	M_a	parameter or constant (varies by context)	N_2O	nitrogen molecule
K-H	Kelvin Helmholtz (waves)	Ma	steady-state antitriptic wind		nitrous oxide
$K\uparrow$	upwelling solar	MA	Mach number	NAAQS	National Ambient Air Quality Standards
$K\downarrow$	downwelling solar	MA	Massachusetts, USA postal code	NaCl	salt
k	absorption coefficient	MAE	mean absolute error	NAM	Northern Annular Mode
	grid index	MB	megabyte	NAO	North Atlantic Oscillation
	height index		Manitoba, Canada postal code	NB	New Brunswick, Canada postal code
	molecular conductivity = $0.0253 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$	M_{BL}	boundary layer wind speed	N_{BV}	Brunt-Va_ isälä frequencyon
	parameter or constant (varies by context)	M_c	speed of movement of a column of air	NC	North Carolina, USA postal code
	vertical data point index	MCC	Mesoscale cellular convection	NCEP	National Centers for Environmental Prediction
	Von Kármán constant = 0.4	M_{cs}	Mesoscale convective complex	ND	North Dakota, USA postal code
k_1	parameter or constant (varies by context)	MCS	cyclostrophic wind	NE	Nebraska, USA postal code
k_2	parameter or constant (varies by context)	MCV	Mesoscale convective systems	Ne	neon
k_B	Boltzmann's constant = $1.3806 \times 10^{-23} \text{ J}\cdot\text{K}^{-1}\cdot\text{molecule}^{-1}$	MD	Mesoscale convective vortex	NGM	nested grid model
kg	kilograms, a mass unit	ME	Maryland, USA postal code	NH	New Hampshire, USA postal code
kg_f	kilograms of force = $ g \cdot\text{mass}$		mean error	$(NH_4)_2SO_4$	ammonium sulfate
kg_m	kilograms of mass	METAR	mechanical energy	NJ	New Jersey, USA postal code
KH	eddy diffusivity for heat	MG	Maine, USA postal code	NL	number of layers
km	kilometers, a unit of length	M_{gust}	meteorological observation code		Newfoundland & Labrador, Canada postal code
kPa	kiloPascal, a unit of pressure	Mi	meridional gradient of zonal momentum	NM	New Mexico, USA postal code
		M_{in}	gust front advancement speed	NO_2	nitrogen dioxide
		MIPS	Michigan, USA postal code	NOAA	National Oceanographic and Atmospheric Administration
			incoming wind speed		
			millions of (computer) instructions per		

NP North Pole
 NS Nova Scotia, Canada postal code
 NSSL National Severe Storms Laboratory
 NT Northwest Territories, Canada postal code
 NU Nunavut, Canada postal code
 NV Nevada, USA postal code
 NVA negative vorticity advection
 NWP numerical weather prediction
 NWS National Weather Service
 NY New York, USA postal code
 n direction pointing toward the center of curvature
 index of refraction
 number density
 number of grid points being averaged
 total number
 n_i refractive index

O

OFM operational numerical weather forecast model
 OH Ohio, USA postal code
 OK Oklahoma, USA postal code
 ON Ontario, Canada postal code
 OR Oregon, USA postal code
 OSSE Observing System Simulation Experiment
 O₂ oxygen molecule
 O₃ ozone molecule

P

P ambient pressure
 perimeter
 period
 power
 pressure
 probability
 sidereal orbital period=365.256363 days
 P₀ sea level pressure = 101.325 kPa
 reference pressure = 100 kPa
 P₁ mean background pressure
 P_A Pascal, a unit of pressure
 PA Pennsylvania, USA postal code
 P_B ambient pressure at bottom of column
 Pb chemical abbreviation for lead
 P_{BV} period oscillation at the Brunt-Väisälä frequency
 PC portion correct
 P_c reference pressure at the center of an anticyclone
 PCA Principal Component Analysis
 P_{dyn} dynamic pressure
 P_e environmental pressure
 PE primitive equation
 P_{earth} Prince Edward Island, Canada postal code
 earth orbital period = 365.25463 days
 PG Pasquill-Gifford
 P_{G_m} mesoscale pressure gradient
 P_{G_s} synoptic-scale pressure gradient
 PIBAL pilot balloon
 PIREPS pilot reports (of the weather in flight)
 P_{moon} lunar orbital period = 27.32 days
 P_{MSL} mean sea level pressure
 POD probability of detection
 PPI plan position indicator
 PPM Perfect Prog Method
 Pr precipitation rate
 probability
 probability of having a given wind speed
 storm period
 P_{rain} pulse repetition frequencies
 PRF
 P_s pressure at sea level
 static pressure
 P_{sidereal} sidereal day = 23.94 h
 P_{STP} standard sea-level pressure = 101.325 kPa
 P_T ambient pressure at top of column
 PVA positive vorticity advection
 PVU potential vorticity unit
 = 10⁻⁶ K·m²·s⁻¹·kg⁻¹
 ppb parts per billion
 ppm parts per million

psf "pounds-force per square foot, a pressure unit"
 psi "pounds-force per square inch, a pressure unit"
 p' pressure perturbation (deviation from hydrostatic)

Q

Q₁ total amount of pollutant emitted
 Q amount
 Q-vector
 source emission rate of pollutant
 Q_A cumulative heating or cooling
 Q_{AK} cumulative heating or cooling in kinematic units
 QC Quebec, Canada postal code
 Q_E latent heat
 Q_H heat added
 q specific humidity
 solar forcing ratio
 q_s saturation specific humidity

R

R_g gas constant in ideal gas law
 R_d gas constant for dry air
 = 0.287053 kPa·K⁻¹·m³·kg⁻¹
 = 287.053 J·K⁻¹·kg⁻¹
 R_v gas constant for pure water vapor
 = 0.4615 kPa·K⁻¹·m³·kg⁻¹
 = 461.5 J·K⁻¹·kg⁻¹
 R radius
 range
 radius from centre of sphere
 cyclone radius
 distance
 R₀ average radius of the earth = 6356.766 km
 smoke-stack top-radius
 net solar input
 critical radius or distance
 parameter or constant (varies by context)
 R₁ RAOB
 RASS radio acoustic sounding system
 R_c radius of curvature
 R_{earth} average earth radius = 6356.766 km, or earth radius at equator = 6378 km
 reference height
 ref
 R_f flux Richardson number
 RFD Rear-flank downdraft
 RH relative humidity
 RHI range-height indicator
 RHS right hand side
 RI Rhode Island, USA postal code
 Ri bulk Richardson number
 Richardson number
 critical Richardson number = 0.25
 RL residual layer
 RMS root mean square (error)
 Ro Rossby number
 ROC Relative Operating Characteristic
 curvature Rossby number
 Ro_c
 RP return period
 RR rainfall rate
 RxL radix layer
 R* critical radius
 r water mixing ratio, a form of humidity
 correlation coefficient
 system response
 reflectivity
 r₀ tornado radius
 r₁ parameter or constant (varies by context)
 rad radians
 r_c critical radius (for escape)
 r_{CL} cost/loss ratio
 R_E excess-water mixing ratio
 average radius of the earth = 6356.766 km
 r_i ice mixing ratio
 r_{inf} background mixing ratio
 r_l liquid-water mixing ratio
 r_s saturation mixing ratio
 r_T total water mixing ratio
 r_w wet-bulb mixing ratio

r_λ reflectivity at one wavelength
 r ratio of e-folding height to inversion strength in the stable boundary layer
 impact parameter
 radius of curvature
 distance of gust from downburst center
 distance from center of earth
 distance from axis of rotation of earth
 distance from center of a hurricane
 mesocyclone radius
 parameter or constant (varies by context)
 radius of earth (see R_{earth})
 distance of hurricane eye-wall wind maximum from the center of the eye
 average drop radius
 constant = 0.02
 earth radius = 6356.766 km
 radius
 reflectivity
 radius of downburst
 parameter or constant (varies by context)

S

S supersaturation
 solar radiative forcing
 shear generation of TKE
 swirl ratio
 South
 solar constant = 1361 ±7 W·m⁻²
 Snell's Law for components
 storm surge height of ocean surface above normal sea level
 S* critical supersaturation
 S** Lagrangian net source/sink of water
 S₀ Average total solar irradiance/solar constant
 internal source of heat per unit mass or internal latent heating rate
 S₁ parameter or constant (varies by context)
 S_A available supersaturation
 SBH sea-breeze head
 SBL stable boundary layer
 SC South Carolina, USA postal code
 SD South Dakota, USA postal code
 SI International System of Units (metric units)
 S_{inf} background supersaturation at a large distance from droplet
 SK Saskatchewan, Canada postal code
 SL surface layer
 SO₂ sulfur dioxide
 SOI Southern Oscillation Index
 SP South Pole
 S_R equilibrium supersaturation adjacent to droplet
 SRH storm relative helicity
 SSM/I Special Sensor Microwave Imagers
 SS_{ROC} ROC skill score
 SST stably-stratified turbulence
 sea surface temperature
 ST standard time in the local time zone
 STP Standard Temperature and Pressure
 S_x dimensionless spread parameter
 s distance
 horizontal distance
 length of side of square
 path length
 seconds, a time unit
 slope
 speed of sound
 streamline
 total entropy
 parameter or constant (varies by context)
 s₀
 sin sine
 sr steradian

T

T temperature
 TORRO tornado intensity scale
 T' amount temperature deviates from the average value

T_s	surface temperature
T_{sfc}	surface temperature
T_0	parameter or constant (varies by context) freezing temperature in Kelvins = 273.15 K
T_1	parameter or constant (varies by context)
T_2	parameter or constant (varies by context)
T_A	temperature of atmosphere
T_B	brightness temperature
T_d	dew-point temperature
TD	turbulent drag
	tropical depression
T_{dyn}	dynamic temperature
T_e	ambient-air absolute temperature temperature of environment effective radiation emission temperature = 255 K
TE	Tennessee, USA postal code
TH	thickness
TIBL	thermal internal boundary layer
TIROS	Television and InfraRed Operational (satellite) System
TKE	turbulence kinetic energy
TL	thermal low
T_m	absolute temperature
TNT	trinitrotoluene (a high explosive)
Torr	a measure of pressure =133.32 Pa
TOVS	TIROS Operational Vertical Sounder
T_p	temperature of katabatic layer temperature of parcel
Tr	required heat transport transport of TKE by turbulence Total atmospheric and oceanic heat trans- port needed to compensate radiation horizontal transport parameter
T_r	net sky transmissivity reference temperature
T_{RL}	residual layer temperature
TROWAL	trough of warm air aloft
TS	Tropical Storm
TSI	total solar irradiance
T_{skin}	temperature of the top few molecules of the Earth's Surface
TSM	total shear magnitude
T_{GR}	sunrise time
TSS	true skill score
T_{STP}	standard sea-level temperature =15°C = 288 K
T_v	virtual temperature
TV	television
TVS	tornado vortex signature
T_w	wet-bulb temperature
TX	Texas, USA postal code
t	time time step time of onset
t_0	time of onset
tan	tangent
tcu	towering cumulus
t_d	length of day/time of day
t_L	Langrangian time scale
t_{orbit}	orbital time period
t_{utc}	Coordinated Universal Time
t_λ	transmissivity at wavelength λ

U

U	tangential velocity of earth velocity in the x-direction wind component toward the east
U_{ag}	ageostrophic wind component to the east
U_d	destination air velocity zonal wind
U_g	geostrophic wind component toward the east
UHF	ultra-high frequency
UHI	urban heat island
U_{jet}	jet stream velocity
UK	United Kingdom
UM	Unified Model
U_r	gradient wind component toward the east
URL	universal resource locator (internet web address)
U_s	zonal velocity
US/USA	United States of America
UT	Utah, USA postal code

U.T.	Upper Tropospheric
UTC	Coordinated Universal Time
U_{TH}	component of the thermal wind
U'	velocity relative to earth
u.	friction velocity

V

V	economic value
	vector wind velocity
	velocity in the y-direction
	verifying analysis
	visual range/visibility
	voltage (in volts)
	volume
	wind component to the north
VA	Virginia, USA postal code
VAD	Velocity Azimuth Display
V_{ag}	ageostrophic wind component toward the north
V_g	meridional geostrophic winds geostrophic wind component toward the north
VHF	very high frequency
V_{in}	inflow velocity
VLF	very low frequency
Vol	volume of water
V_r	gradient wind component toward the North
VT	Vermont, USA postal code
V_{TH}	component of the thermal wind
VV	vertical visibility
v	average molecular speed molecular speed total velocity along a streamline deviation in meridional velocity relative to the mean
v'	deviation in meridional velocity relative to the mean
var	variance
v_e	escape velocity
v_L	velocity of current through the return stroke path in lightning

W

W	velocity in the z-direction
	work
	thermal updrafts
	wave drag
	wave drag
	width
	Watt, a power unit
	West
W_0	stack-top exit velocity
WA	Washington, USA postal code
WBF	Wegener-Bergeron-Findeisen (cold -cloud precipitation formation process)
WD	Wave drag
WER	weak echo region
WI	Wisconsin, USA postal code
W_{mid}	vertical velocity across 50 kPa surface
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting
W_s	subsidence velocity magnitude
WV	water vapor
	West Virginia, USA postal code
WX	Weather
WY	Wyoming, USA postal code
w	terminal velocity
w_0	parameter or constant (varies by context)
w_B	buoyancy velocity scale
w_d	downburst velocity
w_e	entrainment velocity
w_{max}	max updraft or downdraft speed
w_s	synoptic-scale mean vertical velocity (neg- ative for subsidence)
w_T	terminal velocity
w_τ	transport velocity
w_*	Deardorff (convective) velocity scale

X

X	cloud diameter/depth
	dimensionless downwind distance of

		receptor from source
		ratio of heat flux into the ground to the net radiative flux at the earth's surface
Xe	Xenon	
x	abscissa value	
	distance	
	distance downwind	
	distance from centerline	
	distance from front	
	distance toward east	
	path length	
	travel distance	
x'	distance east from arbitrary longitude	

Y

Y	dimensionless crosswind distance of the receptor from plume centerline
	time period of orbit
YT	Yukon Territory, Canada postal code
y	distance toward north ordinate value
	year
yr	year
y'	north-south displacement from center lat- itude

Z

Z	dimensionless receptor height
	radar reflectivity factor
	Zulu Time (= UTC time)
Z_{CL}	dimensionless plume centerline height
Z_{DR}	differential reflectivity
Z_s	dimensionless source (smoke stack) height
Z_T	tropospheric depth (=11km)
z	depth effective atmospheric thickness height vertical distance
z_0	aerodynamic roughness length
z_1	initial amplitude
z_c	reference height at the centre of an anticyclone
Z_{CL}	plume centerline height
z_1	depth of convective mixed layer depth of the atmospheric boundary layer mixed-layer depth
z_{LCL}	lifting condensation level (km)
z_s	physical source (smoke stack) height
z_{stn}	station elevations above sea level
z_T	depth of troposphere =11 km height of topography
z_{Trop}	depth of troposphere =11 km

GREEK SYMBOLS

A, α Alpha

α	angle of ray above horizon
	angle of tilt of wave crests relative to vertical
	component angle
	elevation angle
	local azimuth angle
	parameter or constant (varies by context)
	slope angle
	specific volume = 1/ ρ
	spread parameter
	terrain slope
	wind direction relative to north
α_1	rotation angle about the column axis of an ice crystal
α_3	intermediate calculation parameter
α_5	intermediate calculation parameter

B, β Beta

$\Delta\beta$	beamwidth
β	beta parameter (rate of change of Coriolis parameter with latitude)
	component angle
	constant or parameter (varies by context)
	divergence
	growth rate
	Kalman gain
	rotation angle
β_1	intermediate calculation parameter
β_3	intermediate calculation parameter
β_5	intermediate calculation parameter
β_c	wedge angle
	constant or parameter (varies by context)

Γ, γ Gamma

Γ	lapse rate ($= -\Delta T/\Delta z$)
Γ_d	dry adiabatic lapse rate
Γ_{ps}	pre-storm lapse rate
Γ_s	saturated (moist) lapse rate
Γ_a	standard atmospheric lapse rate $= 6.5 \text{ K km}^{-1}$
γ	crystal orientation with respect to the compass direction of the incoming light ray
	depth parameter
	environmental lapse rate
	potential temperature gradient above the atmospheric boundary layer
	psychrometric constant $= 0.4 (g_{\text{water vapor}}/k_{g_{\text{air}}}) \cdot \text{K}^{-1}$
	volume extinction coefficient

Δ, δ Delta

Δ	change of
Δ^2	Laplacian operator
δ_{ij}	Kronecker delta
δ_s	solar declination angle

E, ϵ Epsilon

ϵ	dissipation rate of TKE
	effective emissivity
	intermediate calculation parameter
	obliquity (tilt of earth's axis) = 23.439°
	ratio of gas constants for dry air and water vapor = $0.633 (g_{\text{water vapor}}/g_{\text{air}}) \cdot \text{K}^{-1}$
	viscous dissipation rate of TKE
ϵ_0	permittivity of free space (see Appen. B)

Z, ζ Zeta

ζ	zenith angle
	vertical vorticity
ζ_a	absolute vorticity
ζ_g	relative geostrophic vorticity
ζ_{IPV}	isentropic potential vorticity
ζ_p	potential vorticity
ζ_r	relative vorticity
ζ^*	dimensionless height

H, η Eta

η'	vertical displacement of a wave
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$\Theta, \theta, \vartheta$ Theta

θ	angle of light ray
	mixed-layer potential temperature
	potential temperature
θ_1	viewing angle
	incident angle
θ_2	viewing angle
	refracted angle
θ_3	reflected angle
θ_a	ambient potential temperature
θ_c	critical angle
θ_e	equivalent potential temperature
	potential temperature of the environment
θ_H	horizontal angle
θ_h	horizontal viewing angle
θ_L	liquid-water potential temperature
θ_{ML}	mixed-layer potential temperature
θ_p	initial gas temperature of effluent from a smoke stack
	potential temperature of an air parcel
θ_{sc}	surface potential temperature
θ_v	vertical angle
	vertical viewing angle
	virtual potential temperature
θ_w	wet-bulb potential temperature

I, ι Iota

K, κ Kappa

Λ, λ Lambda

Λ	parameter or constant (varies by context)
λ	wavelength
	dimensionless wave parameter
	true longitude angle
	climate sensitivity factor
	horizontal scale
λ_d	internal Rossby radius of deformation
λ_r	longitude
λ_R	external Rossby radius of deformation
λ_{max}	wavelength of peak emission
λ_2	parameter or constant (varies by context)

M, μ Mu

μ_{ij}	ratio of refractive indices n_i and n_j
μm	micrometer, a unit of length

N, ν Nu

ν	frequency
	true anomaly

Ξ, ξ Xi

O, \omicron Omicron

Π, π Pi

π	math constant = 3.141 592 653 589 793 238 462 643 dimensionless group
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P, ρ Rho

ρ	density
	average sea-level density = $1.225 \text{ kg}\cdot\text{m}^{-3}$
ρ_0	density of air at sea-level
	density of object
ρ_{air}	density of air
ρ_d	density of dry air
ρ_f	density of fluid
ρ_{HPV}	co-polar correlation coefficient
ρ_i	ice density
ρ_L	density of liquid water
ρ_m	number density of molecules
ρ_{STP}	standard sea-level density = $1.225 \text{ kg}\cdot\text{m}^{-3}$
ρ_v	absolute humidity
	= density of water vapor
ρ_{ve}	excess water vapor density
ρ_{vs}	saturation value of absolute humidity
ρ_{water}	density of water

$\Sigma, \sigma, \varsigma$ Sigma

Σ	summation
σ	backscatter cross-section area
	parameter of constant (varies by context)
	standard deviation
	surface tension
	wavenumber
σ_o	standard deviation of raw observation
σ_1	standard deviation of drop radii
σ^2	variance
σ_f	standard deviation of errors associate with first guess from previous forecast
σ_g	standard deviation of errors associated with first guess
σ_H	cloud-cover fraction of high clouds
σ_L	cloud-cover fraction of low clouds
σ_M	cloud-cover fraction of middle clouds
σ_{SB}	Stefan-Boltzmann constant (see App. B)
σ_y	lateral standard deviation of smoke-plume spread
σ_y^2	lateral variance of smoke-plume spread
σ_{yd}	dimensionless lateral standard deviation of smoke plume
σ_z	vertical standard deviation of smoke-plume spread
σ_z^2	vertical variance of smoke-plume spread
σ_{zc}	vertical standard deviation of crosswind-integrated concentration of pollutant
σ_{zdc}	dimensionless vertical standard deviation of crosswind-integrated concentration

T, τ Tau

τ	optical thickness
	stress
	perihelion date
	time scale
	e-folding time
$\hat{\tau}$	transmittance

Y, υ, Υ Upsilon

Φ, ϕ, φ Phi

Φ	geopotential
Φ_r	tilt of Earth's axis relative to the ecliptic = 23.44°
ϕ	angle between wind direction and sound-propagation direction

latitude
intermediate calculation parameter

X, χ Chi

Ψ, ψ Psi

ψ elevation angle

Ω, ω Omega

Ω ohms, a measure of resistance
 Ω_d angular velocity
angular rotation rate of the earth
 ω angular frequency
 ω_E Earth's rotation rate = 0.0043633 radians/
minute

ϖ Variant Pi

ϖ equinox precession = angle of the
perihelion from the vernal equinox

OPERATORS

$d()$ total derivative
 $\partial()$ partial derivative
 $\Delta()$ difference, or change of
 $\bar{()}$ (overbar) average or mean of
 $()'$ (prime) deviation from the mean
 $[]$ matrix
 $|_z$ at height z
 $|$ absolute value
 $\bar{|}$ amplitude (of wave)
 $\int()$ integral of
 $\Sigma()$ sum of
 $\Pi()$ product of
 \cdot multiplication

SUPERSCRIPTS

$()'$ (prime) deviation from the mean
first guess
perturbation
turbulent variation

SUBSCRIPTS

1 at height 1
2 at height 2
A any quantity
of parcel A
a analysis
ABL, abl atmospheric boundary layer
AD advection
adv advection
ai rays going from air to ice
air of air
avg average
B of parcel B

bottom of troposphere
black or dark daisies
BL boundary layer
BLG boundary layer gradient (wind)
C of parcel C
 $^{\circ}\text{C}$ in degrees Celsius
CCN cloud condensation nuclei
CF Coriolis Force
CN centrifugal force
cond conduction
d destination
flow in the most narrow part of a channel
or mountain pass
E latent heat
e environment
earth
earth of the earth
eff effective
eq equilibrium
final final state
G ground
bare ground
g geostrophic
first guess
H of heat
ia rays going from ice to air
destination index
init initial
j source index
K in Kelvin
k data point index
L liquid
LCL lifting condensation level
left at the left side of a volume or box
liq liquid
max maximum
mid mid-level
at midpoint of column
initial value
ML mixed layer
mtn of a mountain
o mean background value or reference
state
observation
initial condition
p parcel
PG pressure gradient
R reference condition
of radiation
ref reference condition
right at the right side of a volume or box
RL residual layer
RXL radix layer
s surface
source index
upstream flow
SBF of the sea-breeze front
sfc surface
skin at the top molecules of the earth's sur-
face
SL surface layer
SL or sl sea level
SST sea surface temperature
STP standard temperature and pressure
of the sun
T top of troposphere
t at time t
TD turbulent drag
TH thickness
thermal
turb turbulent or turbulence
u u component of wind
v v component of wind
virtual
W white or light daisies
w vertical component of wind
of water
X of parcel X
x variable in the x direction
component toward the east
y variable in the y direction
component toward the north
z variable in the z direction
component in upward direction
 θ potential temperature

λ at one wavelength
 ϕ at latitude ϕ
 $^{\circ}\text{C}$ in degrees celsius
 ∞ at a far or infinite distance away

SPECIAL SYMBOLS

$\$$ computer spreadsheet should be used to
solve this homework exercise
 \mathfrak{S} dynamic flux
 \mathfrak{R} gas constant in ideal gas law
 \mathfrak{R}_d gas constant in ideal gas law for dry air
 \mathfrak{R}_v gas constant in ideal gas law for pure
water vapor
 \bullet key equation or concept
 \cdot multiply operator

